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Gold Nanoparticles Sliding on Recyclable Nanohoodoos as SERS Substrates – Bridging the Gap between Low Cost and Excellent Performance

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The development of nanostructured surfaces as substrates for surface-enhanced Raman spectroscopy (SERS) has been a hot topic in the field, since the success of SERS in practice relies on the availability of highly enhancing, macroscopically uniform, cheap and reproducible substrates. Herein, I present a novel substrate that might prove advantageous with respect to all the expected properties of an ideal SERS substrate.[1] The substrate consists of gold nanoparticles that can slide and aggregate on dense and recyclable alumina/silicon nanohoodoos, which are fabricated in wafer-scale using block copolymer lithography.[2] The substrate can be used for both gas and liquid sensing. Hot-spot engineering is conducted to maximize its SERS performance. The developed substrate demonstrates remarkably large surface-averaged SERS enhancements, greater than 10^7 ($>10^8$ in hot spots), with unrivalled macroscopic signal uniformity as characterized by a coefficient of variation of only 6% across 4 cm. Interestingly, after SERS analyses, the nanohoodoos can be recycled by complete removal of gold via a one-step, simple, and robust wet etching process without compromising performance, minimizing the cost. After 8 times of recycling, the substrate still exhibits identical SERS performance in comparison to a new substrate. Our work facilitates the practical use of SERS for both laboratorial and commercial applications.

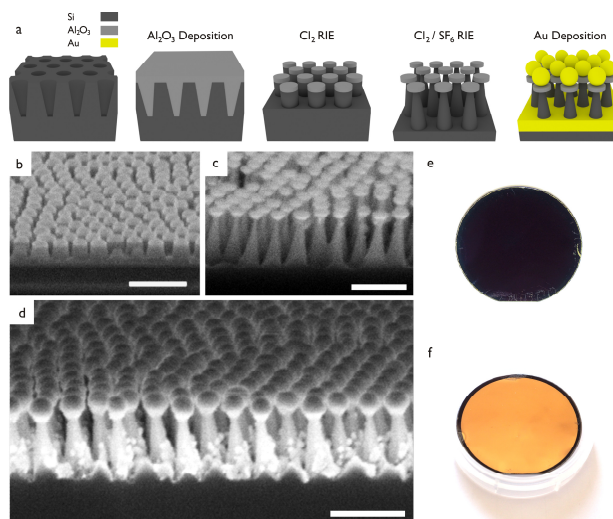


Figure 1. a) Schematic of the nanofabrication. b-d) SEM images taken between and after the last 3 process steps in a). e,f) Pictures of 2-inch wafers covered with arrays of nanohoodoos before and after gold deposition, respectively.

References:

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2. Li, T.; Wu, K.; Rindzevicius, T.; Wang, Z.; Schulte, L.; Schmidt, M. S.; Boisen, A.; Ndoni, S. *ACS Appl. Mater. Interfaces* **2016**, 8, 15668.